Productivity: A Selective Survey of Recent Developments and the Canadian Experience

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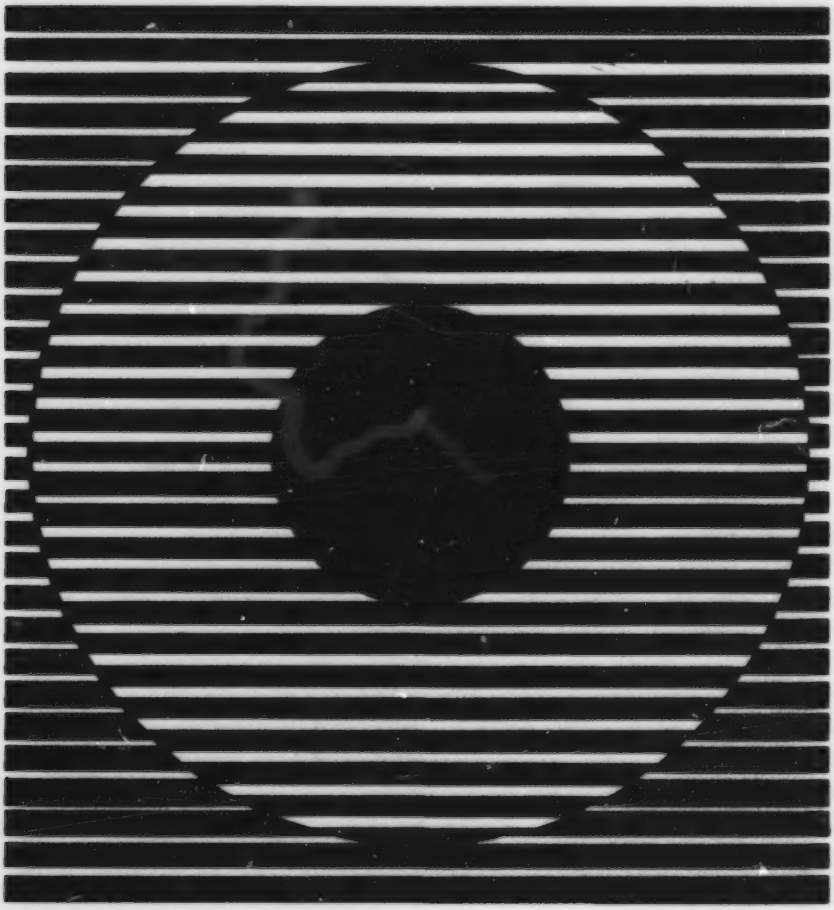
Michael Denny
and Melvyn Fuss

Discussion Paper Series



PRODUCTIVITY: A SELECTIVE SURVEY OF RECENT DEVELOPMENTS AND THE CANADIAN EXPERIENCE

by Michael Denny and Melvyn Fuss

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Ontario Economic Council

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81 Wellesley Street East
Toronto, Ontario
M4Y 1H6

Printed in Canada

Canadian Cataloguing in Publication Data
Denny, M. (Michael)
Productivity

(Discussion paper series / Ontario Economic Council
ISSN 0702-0643)

Bibliography: p.
ISBN 0-7743-7581-7

1. Labor productivity--Canada. 2. Industrial productivity--Canada. I. Fuss, Melvyn A. II. Ontario Economic Council. III. Title. IV. Series: Discussion paper series (Ontario Economic Council)

HC120.L3D4 338.0971 82-093013X

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This report reflects the views of the authors and not necessarily those of the Ontario Economic Council or the Government of Ontario. The Council establishes policy questions to be investigated and commissions research projects, but it does not influence the conclusions or recommendations of authors. The decision to sponsor publication of this study was based on its competence and relevance to public policy.

CONTENTS

Tables

1
Introduction 1

2
Productivity: a conceptual overview 3

3
Productivity: four broad areas of investigation 14

4
The long-run growth in Canada's productivity 16

5
The Great Productivity Slowdown 21

6
International comparisons 36

7
Inter-regional comparisons 45

8
Closing comments 53

Bibliography 55

TABLES

1 Productivity in Canada: major subperiods (average annual percentages) 18

2 Productivity in the United States, Norway, and Canada (annual average percentages) 19

3 Canadian labour productivity in the postwar period (output/person employed, annual average percentages) 22

4 The productivity slowdown in regional Canadian manufacturing, 1961-75
(average annual growth in total factor productivity) 25

5 Productivity and growth in the United States domestic business economy, 1948-78 (average annual percentages) 28

6 Rate of growth of labour productivity by sector: United States (average annual percentages) 29

7 Sources of growth of labour productivity, U.S. nonresidential business
sector (average annual percentages) 30

8 Denison's catalogue of possible additional causative factors in productivity slowdown 31

9 Labour productivity growth: U.S. private sector, 1947-74 32

10 Aggregate performance indicators for Canada and selected countries in the postwar period (average annual rates of growth, percentages) 38

11 Total factor productivity relative to United States (U.S. = 100.0 in each year) 39

12 Relative labour productivity levels (Canada's labour productivity as a percentage of United States') 42

13 Income and productivity levels, Canadian and provinces, 1970-3 (all Canada = 100) 47

14 Variations in regional labour productivity: the role of industry structure, capital intensity, and labour quality 48

15 Regional productivity in Canadian total manufacturing 50

16 Regional labour productivity in manufacturing 52

1
INTRODUCTION

Few people question the importance of productivity as a determinant of the welfare of individuals and countries, but active interest in the subject waxes and wanes as world events focus our attention on or distract it from this particular aspect of our economies. At the moment, interest in productivity is high, rising from concern about slowdowns in the rates of real output growth experienced world-wide since the early 1970s.

This paper is a survey of the status of our theoretical and empirical knowledge about productivity. It is selective, involving some very definite choices about content and presentation. First, we hope that we have written for a broad audience. It is not a survey for academics only (although we hope that it will be of some use to them), and, it is certainly not a survey for the smaller group of productivity researchers, who will undoubtedly lament our treatment of some fine points. Particularly in dealing with concepts, we have tried to emphasize basic issues and the structure of the problems, leaving readers to investigate the more technical literature themselves.

The survey is organized into two major parts: one on concepts and methodology, the other on empirical investigations. The first describes and interprets the methods currently used to measure productivity. In it, we have emphasized recent developments but tried to keep the material accessible to the lay reader. It is important that a broad audience be able to judge the meaning and implications of empirical productivity studies.

The empirical evidence on Canadian productivity is presented in the second part, which we have divided into four sections. First, we offer some information about long-run trends in Canadian productivity. This basic evidence is relatively slight, since Canadians have not done an adequate job of investigating the history of their own productivity, but it is important background for understanding more recent developments. In other words, our recent troubles with lagging productivity growth are

clarified when seen in historical perspective. The second section is an extensive discussion of the recent productivity slowdown in Canada. In addition, since Canadians have not investigated the sources of the slowdown as extensively as Americans, evidence from that country is used to expand the studies of our own experience. The third section covers a subject of perennial interest: Canadian-U.S. comparisons of productivity. It surveys this literature with some extensions to indicate the broader nature of current research on international differences in productivity. The last empirical section investigates our knowledge about the differences in productivity among the regions of Canada. Are traditional beliefs about regional differentials supported by recent evidence? Are there any trends in these differentials?

The study ends with a bibliography that is broader than our survey. It includes some of the major empirical work done outside Canada, studies that are not fully discussed in the text, although some are mentioned there. We have not included material published before 1970 except for Canadian items. A good bibliography of this older work can be found in Nadiri (1970) and a more specialized one on international comparisons in Kravis (1976).

2

PRODUCTIVITY: A CONCEPTUAL OVERVIEW

The basic concept of productivity is quite simple; more detailed considerations, however, lead us into a thicket of distinctions and difficulties that are not easily resolved. We begin with an overview that will gently introduce the reader to some of the thorns in the thicket.

Measuring productivity: a simple case

In measuring productivity, we are attempting to assess the performance of the economy (or some part of it) in using real resources, which are limited, to produce goods and services. For the theoretical case of only one, well-defined output and a single input, the productivity level equals the quantity of output produced per unit of input, and the productivity growth rate is simply the change in this level over time.

In this simple case, many of the conceptual and measurement problems of studying productivity disappear, but there remain distinctions concerning its interpretation. Economists often find it useful to link productivity to the theory of production, using the concept of the production function, whose value equals the maximum output that can be produced with any particular quantity of the input. When this linkage is made, changes in productivity are often identified uncritically with shifts in the production function. The two may be equivalent under particular circumstances, as discussed later.

Economists often analyze these shifts in the production function as 'technical change'. It is hard to believe that anything other than technical change creates increased productivity in the long run. Over shorter periods, however, this may not be true. Changes in productivity may be significantly affected by the degree to which resources are used efficiently - that is, the degree to which the output produced by the available inputs approaches the maximum possible.

Technical change, efficient production, and scale economies

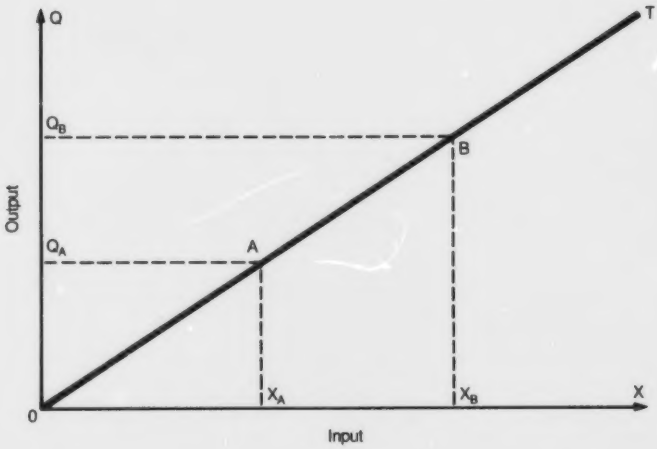
It is important to understand the distinction between productivity and technical change. Productivity studies vary widely in the extent to which they link productivity to technical change and thus to the economic theory of production. The extreme alternative, chosen by almost no one, treats productivity analysis in isolation from the economic theory of production. Such analysis is a predominantly empirical exercise and little interpretation is possible. If, however, one wishes to bring productivity analysis under the powerful wing of economic theory, then one must use the production function and emphasize the relation between technical change and productivity change.

It is our belief that interpreting any form of productivity analysis requires some appeal to economic theory. A discussion of the links between productivity analysis and the economic theory of production should clarify the reasons for our belief and suggest some of the important questions this route permits one to analyze.

The links are illustrated in Figures 1 and 2. Observe input-output combinations A and B in Figure 1. Both points lie on the straight line OT. Since productivity is simply output per unit of input, its value equals the slope of the line OT. Productivity is the same at points A and B. Now suppose the line OT represents the production function. Any input-output combination on or below OT is feasible, all points on the production function are efficient, and both A and B lie on the production function. But this example is a special case in which observed production is efficient and the production function is linear, implying that increasing the input quantity by any factor increases output by the same factor.

In Figure 2, we have the same observed points A and B; however, we have introduced two possible nonlinear production functions, NN' and MM'. Productivity, measured as output per unit of input, equals the slope of the line OT at both points. Suppose the production function is NN' for both observation points. At point A, production is inefficient since with input quantity X_a and a production function NN', the output level Q_a is lower than the efficient level by the amount AD. Point B, however, lies on the production function and is, therefore, efficient. In other words, although the levels of productivity in this situation are constant at A and B, there is a change from inefficient production at A to efficient produc-

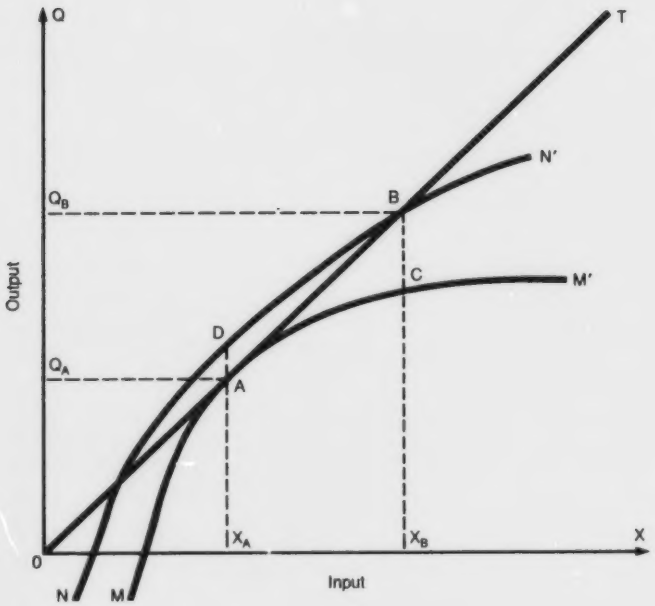
Figure 1
A linear production function: a special case



tion at point B. In this example, the reduction in productivity caused by decreasing returns to larger-scale production is just offset by the increase in productivity caused by more efficient resource use.

Suppose we create a different case. In Figure 2, let the relevant production functions be MM' at point A and NN' at point B. At both points, production is efficient and productivity is the same. However, the production function shifts out to NN' at point B from MM' at point A. We can call this shift technical change or technical progress, since more output can be produced with any level of input when the production function is NN' rather than MM'. The identical productivity levels at A and B reflect the efficiency gains caused by technical change being offset by the efficiency losses caused by decreasing returns to scale. (The latter is the term used to describe the less-than-proportional increase in output as all inputs are increased for any nonlinear production function.) The movement from A to B can be divided into two parts: A to C and C to B. The movement along MM' from A to C leads to a fall in productivity. The

Figure 2
Two nonlinear production fuctions



technical change component, B to C, raises productivity back to the level initially observed at A.

In summary, we now have a framework that allows us to interpret any observed productivity levels, such as those at points A and B. The introduction of the notion of a production function permits us to decide if production is efficient or inefficient at any point. The curvature of the production function, representing returns to scale, shows the changes in productivity that occur as the input and output levels change with more efficient production. Finally, the shift in the production function, which we have associated with technical change, is presumably caused by the introduction of new, more efficient production processes.

Disaggregating the components

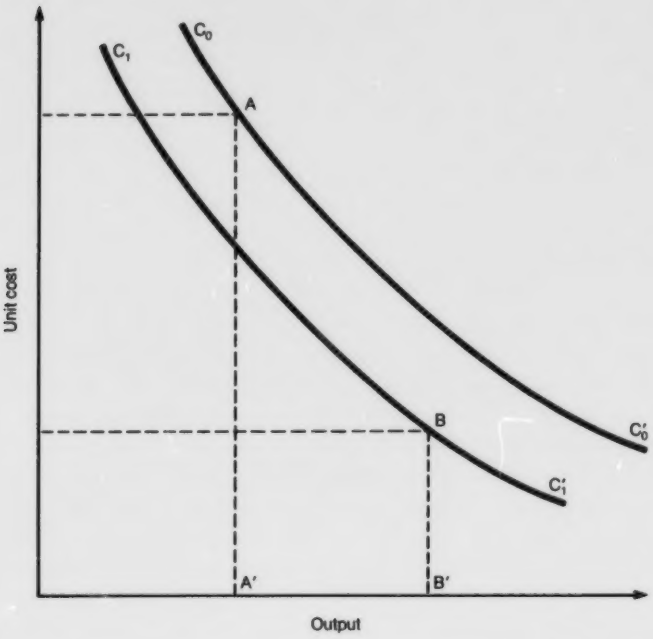
Our example should clarify the three-way distinction between efficient production, scale economies, and the technical change. Each may alter observed productivity. Unfortunately, in determining the level of and changes in observed productivity, sorting out their relative importance can be difficult. This problem is treated in a number of ways. Many productivity studies ignore the distinctions and simply measure, describe, and compare productivity numbers. Most studies that use the production-function framework assume a priori that production is efficient. (Nishimizu and Page [1981] is a notable exception.) Often researchers restrict the curvature of the production function so that productivity is independent of the scale of operation (in other words, they assume constant returns to scale). In this set of restricted circumstances, changes in productivity must equal technical change. Two justifications for this type of approach are possible. First, in the long run, it is undoubtedly technical change that accounts for the largest portion of productivity growth. (It is this fact that has led to a concentration of interest on technical change.) Second, the empirical difficulties of separating the three components of productivity growth convince some researchers to proceed with restricted assumptions, and the assumption of constant returns to scale often appears reasonable for aggregate data sets.

Yet despite these difficulties inherent in any attempt to break productivity differentials into their components, several such studies have been carried out in recent years. Nishimizu and Page (1981) divided productivity growth in Yugoslavian industry into the effects of efficient production changes and those of technical progress. Denny, Fuss, and Waverman (1981) studied the effects of technical change and economies of scale on productivity growth for Bell Canada.

Cost-efficiency growth

A concept analogous to that of productivity growth is cost-efficiency growth. Cost efficiency is defined as real production cost per unit of output, so cost-efficiency change is simply the change in unit production costs less the effect of changes in factor prices. Just as we previously related productivity to the productivity function, we can link cost to the cost function, which is defined as the function that specifies the minimum

Figure 3
Cost-efficiency growth



costs of production for a particular level of output and a particular set of factor prices.

Cost-efficiency growth can be disaggregated into the effects of behavioural efficiency (distance from the cost-function frontier), economies of scale, and technical change. Figure 3 should clarify the sources of cost-efficiency growth. Observe points A and B. We assume that production is behaviourally efficient so that each unit cost-output observation is on the frontier of one of two unit-cost curves, C_0C_0' and C_1C_1' which slope downward to represent increasing returns to larger-scale production. We assume the lower cost curve, C_1C_1' is the result of a shift caused by technical progress. We also assume that both curves embody the same factor prices. The distance from AA' to BB' measures a decline in unit

cost and hence cost-efficiency growth. This growth results from technical progress (a reduction in unit cost at all levels of output) and from scale economies (through a growth in output from A' to B').

Breakdowns of cost-efficiency differences along the lines suggested by this example have been carried out by Denny, Fuss, Everson, and Waverman (1981) for Bell Canada and by Kim (1982) for Canadian trucking.

Under the assumption that unit cost is independent of the level of output (constant returns to scale), cost-efficiency growth is equal to the negative of total factor productivity growth. Hence cost data can be used to compute total factor productivity growth rates and level comparisons (Denny, Fuss, and May [1981]).

Multiple outputs and inputs: aggregation and quality

Introducing multiple inputs and outputs vastly increases the possible definitions of productivity, the methodologies used, and the problems involved. Let us begin by considering the simple case in which a single output is produced by three inputs: capital, K; labour, L; and materials, M.

This case can illustrate several common definitions of productivity. One is total factor productivity, which compares the output level, Q, to the aggregate input level. For example, define the aggregate input quantity as F = f(KLM); total factor productivity may then be defined as the ratio Q/F.

The choice of the aggregator function, F, has been the source of considerable discussion during the last decade. The researcher must use some method of combining the quantities of capital, labour, and materials used for a given production activity into a single aggregate quantity. The development of this methodology properly belongs to index number theory, and we do not intend to survey the large literature on that topic, only to use the material that is relevant for our task.

Diewert (1976, 1980) emphasizes the links between particular index number formulas and particular functional forms for production technology. Any index number formula has a production function that corresponds to it exactly. (In other words, the value of the aggregate input index for a given set of inputs exactly equals the value of the output for the particular functional form.) Thus, implicit in the choice of an index number

is the exact production function to which it corresponds. When we choose an index number, we are assuming that the true production function either is or may be approximated by the one that is exact for our index number.

This is a very useful idea since it permits us to evaluate alternative index numbers in terms of the suitability of the production function for which any index number is exact. Diewert advises the selection of what he calls a 'superlative' index number - one exact for a production function that can provide a second-order approximation to any true production function. Generally, we concur with his suggestion. The use of a superlative index number permits the researcher to avoid very restrictive assumptions about the production technology, a desirable situation unless one has particular information about the nature of the technology.

In practice, simpler indexes may suffice in the sense that the actual value of the index is very insensitive to the choice of index number formula. Experience suggests that the most important characteristic of an index number formula is the variability of its weights. Fixed-weight formulae tend to be misleading.

Alternative output measures

The definition of output may vary significantly for different productivity studies. There is widespread use of net output measures and growing but more limited use of gross output measures. Gross output equals the nominal or the real value of shipments plus changes in inventories. Net output equals gross output less inputs of materials and labour, again in nominal or in real terms. When real values are used, a net output measure almost always shows a greater productivity growth than does a gross output measure, although the exact relationship depends on the precise manner in which net output is calculated.

Net output measures present two problems. First, they imply that the production technology is separable and consequently that the elasticity of substitution between materials and labour is identical to the elasticity of substitution between materials and capital. Second, the only practical methods of measuring net output imply even stronger restrictions since they require that materials be perfect substitutes for both capital and labour. This is certainly unrealistic.

By arguing that the practical procedures for measuring net output are approximations, one can partially rescue standard net output data. In

many cases, however, researchers can obtain sufficient information to use gross output rather than net. Yet there remain many practical situtations in which they can do no better than to proceed with net output.[1] In these cases, one must be careful to realize the errors that may result from the restrictive nature of the implicit assumptions.

Comparative efficiency

A recent and interesting conceptual development has been an improvement of our understanding of the interpretation of interspatial comparisons of productivity. Jorgenson and Nishimizu began the work in a paper (1978) comparing Japan and the United States. Since then, a number of further studies have covered both the development of concepts, as represented in works by Denny and Fuss (1980, 1981) and Caves, Christensen, and Diewert (1981), and empirical applications to manufacturing, telecommunications, railways, airlines, and trucking, as found in Denny (1980), Denny, Fuss and May (1981), Denny, de Fontenay and Werner (1982), Caves and Christensen (1980), Caves, Christensen and Tretheway (1981) and Kim (1982).

Of course, it has always been possible to compute the productivity levels of two or more firms, regions, or nations and then use the relative levels as a measure of comparative productivity. Conceptual issues arise because of possibility of different prices. One would like to know how much output is produced in one firm compared to another using exactly the same inputs; since such observations are impossible, the research must make some adjustment. The recently developed methods for doing so may be explained in the following way. We do not have data on the output of each firm at a common input level, but by making certain assumptions, we can find the average of the unobserved relative productivity levels. It is then possible to break down the differences in relative productivity levels into differences in the quantities of outputs and inputs, and if one has enough information, to break out the effects of scale, regulation, and noncompetitive prices. The possibilities can be extended. (Notice, however, that they all depend crucially on data that may be difficult to obtain and that may present statistical problems for extracting the required information.

1 Agencies that gather and disseminate statistics tend to produce measures of net output. Data on gross output can be very difficult to obtain.

information.)

The analysis may also be done from the cost side, adjusting costs for differences in input prices and output levels.

These methodological developments suggest that one can give a rigorous interpretation of interspatial comparisons that depend only on information about the prices and quantities of inputs and outputs. For the interpretation to be firm, however, one must restrict the extent to which the production technologies of the various units may differ. Nevertheless, the information contained in any comparison may be descriptively useful.

Definitions of productivity in practice

As we have seen, the definitions of productivity vary, and this variation can lead to confusion over the magnitude of productivity growth. Let us briefly consider four of these definitions: total factor productivity and labour productivity in both their gross- and net-output forms.

The gross-output form of total factor productivity uses gross output and a complete list of inputs - capital, labour, and materials. Net-output total factor productivity uses net output and only the inputs of capital and labour. Labour productivity in either output version ignores all inputs but labour. Labour productivity growth can always be related to total factor productivity growth because it equals total factor productivity growth plus factor-intensity growth. (The latter is simply the weighted growth of the capital-to-labour ratio in the net-output case and the weighted growth of both the capital-to-labour and materials-to-labour ratios in the gross-output case.) In most empirical applications, labour productivity grows faster than total factor productivity because factor-intensity growth tends to be positive.

The relationship between gross and net productivity growth rates is slightly more complex. For labour productivity, the gross-output growth rate is smaller (or bigger) than the net-output rate if output is growing faster (or slower) than material inputs. The difference in the two productivity growth rates may be quite sizeable if material inputs are a large share of total costs. For total factor productivity, the relationship between net and gross growth rates is even more complex, but the net-output rates are usually the larger.

These differences mean that the reader must be careful in comparing the results of two or more productivity studies, including the data we

present in the tables in the following sections. We have not been able to place the empirical results of a large variety of studies within a common productivity framework. Therefore, the reader must not compare magnitudes across the studies without carefully investigating the definitions of productivity used in the original sources.

Another warning against interstudy comparisons derives from the fact that identical changes are sometimes captured as changes in inputs or outputs by one author and as changes in productivity by another. For example, some authors show the increasing average education of the labour force as an increase in productivity by adjusting the labour-input measure so that more education implies an increase in productivity. Others adjust the labour-input measure so that more education implies an increase in labour input. Another variation is in the treatment of scale economies. As we have seen, some researchers include them as a part of productivity; others measure productivity after netting out their effects.

Once again, we warn that studies can be compared validly only if one is aware of how the variables have been measured and of what definitions of productivity have been used.

3
PRODUCTIVITY: FOUR BROAD AREAS OF INVESTIGATION

Turning to empirical investigations of productivity, we have chosen to concentrate on four major areas that have been of concern for a long time and/or have received considerable attention recently. None of them can be properly understood without some grasp of the conceptual, theoretical, and measurement problems already presented.

The first such subject is the historical growth in productivity underpinning most of the long-run increases in real per-capita income in Canada. That is, our ability to produce more with given resources through time has provided the basis for increased real per-capita income. It has not been the only determinant of this growth, but it has been its core. A look at the long-run growth in Canada's productivity can provide some perspective on developments since the Second World War, so it is with the long-run that we begin.

We then turn to more recent data. In contrast with the more distant past, the last decade has seen the mystery of what some researchers term the 'Great Productivity Slowdown', an extremely sharp decline in the productivity growth rates of many industries and many countries, including Canada. As an empirical phenomenon, this decline has been the source of great concern, particularly in the United States, where its interpretation, attempted explanation, and projection have been an active industry (of rather limited success) during the past five years or so.

Our two remaining subjects pertain to comparative rates of growth and levels of productivity. Our first comparisons are investigations of Canada's relative position in the international arena. Many such comparisons are possible and several appear here, but one is emphasized. Part of the political fabric of this country is the continual bittersweet debate about the relative welfare of Canada and the United States. Interest in this particular international comparison dominates all the other possibilities.

We then discuss comparisons of productivity within Canada. Since pre-Confederation days, a persistent theme in Canadian political discussion has been regional differentials in real per-capita income. Underlying these differences are regional variations in the rates of growth and levels of productivity.

None of these subjects is truly separate from the others. The long- and short-run performances of Canada's regions determine our national situation, which can be compared with any other country's for whatever time period is desired, although data problems may prevent implementation of some comparisons. To avoid an overly complex, integrated discussion, we have used these four subject areas to provide a framework for our empirical survey.

4
THE LONG-RUN GROWTH IN CANADA'S PRODUCTIVITY

Surveying the country's historical growth in productivity is an interesting exercise in itself, but the major purpose of this section is to provide perspective for Canada's performance during recent periods. Is there a simple, direct connection between the historical pattern and the recent short-run picture? Indisputably, substantial variations exist not only in the annual rates of productivity growth but also in the average rates for any given five- or ten-year periods. According to one hypothesis, it is not possible to know exactly why one decade saw very high growth in average annual productivity and another decade did not. The long-run average simply nets out the good and bad periods to state what the overall change has been.

Placing any stronger interpretation on the long-run average entails a willingness to argue that the long-run average growth in real output or in productivity must remain within quite narrow limits. And some people are indeed willing to take this position, saying that the growth rates of real output are confined by upper limits on long-term resource growth and presumably by similar limits on the productivity growth rate.[2]

If one accepts the latter hypothesis, then one's evaluation of recent poor growth is tempered. We believe, however, that it is useful to present the long-run evidence without implying full acceptance of this theory. One may reject it as unproven (or too imprecise for proof) and assess the long-run information as desired.

2 It must be emphasized that these are empirical arguments, not logical deductions, about limits. One need not claim the ability to place precise numerical values on these limits to believe that evidence suggests a relatively narrow range for the long-run rate of growth and that growth patterns sharply above or below the long-run trends are unlikely to persist.

Productivity growth in Canada

The statistical record for Canada's economic growth and productivity is not particularly long or well developed. The data from before 1890 are incomplete and do not permit an analysis of productivity. From 1890 to 1966, average annual real output growth equalled almost 3.5 per cent. The equivalent growth in labour input was approximately 1.25 per cent and in labour productivity, approximately 2.25 per cent. This historical pattern continued until about 1973, when the growth rate plunged. Very low productivity growth rates have continued for the past eight years, and a sharp, rapid turnaround seems unlikely. On the other hand, we believe that the next decade will see a slow recovery to productivity growth rates close to the historical average. That is, we reject any hypothesis that we have arrived at a sharp break in the historical pattern of productivity growth.

The long-run average smooths some trends of subperiods.[3] Table 1 presents the data for three major periods: 1891 to 1910, 1910 to 1926, and 1926 to 1956. From 1891 to 1910, output grew quickly, and the rates of growth of capital and labour inputs were higher than for any other comparably long period in the country's history. This was a time of large-scale immigration and the settlement of the Western provinces. Labour productivity grew slowly at 1 per cent a year and total factor productivity at 0.75 per cent. Relative to the sixty-five-year average, both types of productivity grew slowly. This may not be surprising, given the early stage of Canadian development.

During the second period, 1910 to 1926, the growth of output, labour, and capital slowed substantially. The net effect was a 15 per cent increase in annual labour productivity growth, to 1.2 per cent, and a 50 per cent increase in total factor productivity growth, to 1.16 per cent. The improved growth in total factor productivity was offset by a decline in the growth of the capital-to-labour ratio.

The final period, 1926 to 1956, was characterized by a sharp increase in the output growth rate, a sharp decline in the growth of labour input, and a near doubling of the capital growth rate. Total factor productivity growth improved dramatically and was reinforced by a large improvement in

3 For convenience, we use here material developed by Lithwick (1970) from primary sources, which he cites.

TABLE 1
Productivity in Canada: major subperiods (average annual percentages)

	1891-1910	1910-26	1926-56
Growth			
Output	3.38	2.46	3.89
Labour	2.31	1.25	0.77
Capital	3.82	1.47	2.86
Contributions			
Labour	1.82	0.98	0.58
Capital	0.81	0.31	0.61
Total factor productivity	0.75	1.16	2.70

SOURCE: Lithwick (1970)

the growth of the capital-labour ratio. These two factors resulted in labour productivity growing at a spectacular rate of over 3 per cent.

Comparing growth patterns

Comparable results for Norway and the United States are reported in Table 2. Some consistent patterns show up across pairs of countries, but few are present across all three. During 1889 to 1909, the United States had very high growth rates of output and both inputs, a pattern similar to Canada's. In the U.S., these rates of growth were not equalled in the later periods, when there were downward trends in all these series. Like Canada, the U.S. experienced an upward trend in total factor productivity over all the periods. In both Canada and the United States, labour productivity growth was highest during the final period, although the U.S. did not have the sharp increase experienced in Canada because the American growth in output and particularly in capital was slow relative to the Canadian.

Norway had the highest total factor productivity growth over the complete period, but its patterns are different from Canada's and the United States'. Labour input in Norway has never grown at the rapid rates of the U.S. and Canada. (The comparative modesty of the increase in Norway is a consequence of the absence of new settlement in that country while the others experienced huge waves of immigration.) Norwegian labour productivity grew slowly during the first period because

TABLE 2
Productivity in the United States, Norway, and Canada (annual average percentages)

	United States		
	1889-1909	1909-29	1929-57
Growth			
Output	4.23	3.17	2.95
Labour	2.26	1.22	0.53
Capital	4.78	2.74	1.01
Contributions			
Labour	1.45	0.83	0.41
Capital	1.72	0.86	0.23
Total factor productivity	1.07	1.48	2.31

	Norway		
	1877-99	1899-1930	1930-56
Growth			
Output	1.72	2.76	2.85
Labour	0.68	0.20	0.32
Capital	1.87	2.34	2.62
Contributions			
Labour	0.54	0.16	0.25
Capital	0.39	0.49	0.54
Total factor productivity	0.79	2.12	2.05

	Canada		
	1891-1910	1910-26	1926-56
Growth			
Output	3.38	2.46	3.89
Labour	2.31	1.25	0.77
Capital	3.82	1.47	2.86
Contributions			
Labour	1.82	0.98	0.58
Capital	0.81	0.31	0.61
Total factor productivity	0.75	1.16	2.70

SOURCE: Lithwick (1970)

of very slow output growth. In the following two periods, however, its labour productivity grew relatively quickly, reflecting a rapid rise in the total factor productivity growth rate and a substantial improvement in the

capital-to-labour ratio.

All three countries' productivity growth rates were substantially larger after 1910 than before, and Canada and the U.S. had much higher rates after the late 1920s. It is extremely difficult to project these rates into the future, but we must provide some interpretation of the possible relevance of the historical experience.

First, the historical data reveal substantial variability in the rates of productivity growth in Canada and elsewhere. We should not be surprised if this reoccurs. Second, during the seventeen years after 1956, Canadian productivity continued to grow at rates well above the average for 1890 to 1956 but slightly below the rates for 1926 to 1956. The U.S. also followed this pattern from 1958 to 1973, although its falloff from the previous subperiod was somewhat greater than Canada's. This similarity in the patterns in the two countries requires further research. Third, we must accept the idea that the historical record is very poorly understood and cannot be used to predict the short-run future precisely.

5

THE GREAT PRODUCTIVITY SLOWDOWN

The evidence from almost all developed Western countries suggests that during the past decade the rate of productivity growth slowed significantly. We refer to this phenomenon as the Great Productivity Slowdown.

The Canadian situation

The Canadian situation is summarized in a recent Department of Finance study:

> Since 1973 labour productivity in Canada has grown at a much slower average rate than it did over much of the postwar period. Part of the post-1973 slowdown in productivity growth is related to the cyclical performance of the economy over this period. The extent of the slowdown appears to have been larger than can be accounted for by cyclical factors alone, however, and has led to the suggestion that the trend growth rate of productivity in Canada has declined in the 1970s. (Canada 1980)

There is no doubt that widespread declines in the rates of productivity growth have been common in Canadian industries. Table 3 uses data from the Department of Finance study to present a temporal overview of the output per person employed in major sectors of the Canadian economy. All major sectors except agriculture show a sharp decline after 1973. This finding is consistent with the more limited results reported by Ostry and Rao (1979) and the disaggregated manufacturing results of Denny, Fuss, and May (1981).

Why has the slowdown occurred? The Department of Finance study is almost the only recent Canadian attempt to answer this question, and it is unable to provide a satisfactory reply, although it examines numerous possibilities. Since the post-1973 period has also been one of slow output growth, one hypothesis is that the productivity slowdown is not a secular

TABLE 3
Canadian labour productivity in the postwar period (output/person employed, annual average percentages)

	1957-56	1957-66	1967-73	1974-78
Total economy	3.5	2.1	2.5	0.5
Commercial sector (total)	4.1	3.0	3.2	1.4
Goods	5.7	4.5	4.4	2.1
Goods, nonagricultural	4.2	3.8	4.3	1.9
Services	1.3	1.2	2.2	0.9
Agriculture	7.0	5.5	1.7	4.4
Manufacturing	3.3	3.8	4.5	2.8

SOURCE: Canada (1980, Table 9)

phenomenon but a cyclical downturn. The separation of a cyclical downturn from a secular shift with long-run consequences is, of course, not easy. However, the Department of Finance study (as well as many American works) argues that cyclical factors cannot explain the severity and length of the downturn in productivity growth.

We believe, however, that many studies, including the one by the Department of Finance, use overly simple techniques to make this judgement. It would be more useful to say simply that the recent pattern of productivity declines does not conform with previous postwar declines associated with the business cycle. Logically, one cannot presume that this lack of conformity implies a secular shift with long-run consequences. The latter may be known only after the fact. Our brief historical survey suggests that substantial variations in average productivity growth are not unusual, even over decades. If we are currently moving through a period of slow productivity growth rates, we should remember that earlier historical periods also experienced them. In fact, we should be cautious about presuming that sustained high rates of productivity growth are attainable.

The Finance study also investigates several other possible sources of the productivity slowdown in Canada. It finds that changes in the demographic composition of the work force and in average hours worked per employee were not significant factors. Neither was the shift of employment from goods-producing to service industries. Productivity fell in both sectors - by more in the goods-producing than in the service - and the net effect was quite small. Environmental regulations were also not an

important factor.

The Department of Finance study finds only two factors of significance in explaining the cyclically adjusted productivity decline for the whole economy. One is the extreme decline in the productivity of the oil- and natural-gas-related industries, caused by sharp changes in world prices and government policies. The second is slow growth in the capital-to-labour ratio.

The declines in labour productivity in the oil- and gas-related industries arose from a decline in output combined with a growth in employment, both of which were induced by changes in government policies and by world oil prices. In the oil industries, output has declined substantially in both primary production and in pipeline activity, yet increased exploration and development have meant a continued growth in employment. A similar, although less severe, change has occurred in the natural gas industry. Neither of these situations is likely to improve quickly. Current world energy prices make it worthwhile to expend large quantities of resources for locating, developing, and producing oil and natural gas. The rate of growth of world energy prices has slowed down, however, and is unlikely to regain its earlier high levels. Consequently, the level of productivity in energy-producing industries may be low for some time, though it should not continue to fall sharply.

The mention of energy demands an aside at this point. The worldwide decline in productivity growth is often dated roughly from 1973, the year of the oil crisis provoked by the Organization of Petroleum Exporting Countries. Moreover, since productivity declines are so widespread, it is very tempting to assert that they must have some common cause. Yet finding it has proven an elusive task. Beyond association, there is no conclusive evidence linking the rapid shifts in world energy prices with the productivity growth slowdown. We will return to this issue later in more specific cases. At this point, we need an interpretation of the limited Canadian evidence from the natural gas and oil industries.

The Finance study's conclusions

During the period that began in 1973, the relative prices of energy rose sharply, reducing demand growth. Government policies reduced energy production absolutely. Both drops left production and distribution facilities underutilized and disrupted long-range capital plans. Assuming

that they do not reoccur, they are short-run phenomena whose impact will decline. The longer-run impact within the energy-producing sector arises from the supply-side effects of the higher relative prices of energy. They justify more costly production, which will increase the level of real resources per unit of energy output and hence reduce productivity in the sector.

Short run or long run, these changes in the energy sector do not provide an explanation for the productivity declines observed throughout the total economies of the industrialized nations. Let us look more closely at other factors in the Canadian situation.

As we have seen, growth in labour productivity can always be divided into growth in total factor productivity and growth in factor intensity. Measurement by total factor productivity accounts for a change in any factor of production. Labour productivity can rise because total factor productivity rises and/or because labour has been provided with a larger quantity of other inputs - for example, capital per unit of labour.

The Department of Finance study finds that declines in factor intensity growth, measured as the growth in the capital-to-labour ratio, are the second most significant factor in the overall decline of labour productivity. Although the study uses questionable methods to measure the cyclically adjusted growth rates of the capital-to-labour ratio, the importance it gives to this phenomenon is not surprising. Growth in factor intensity is always important in labour productivity growth, and it would be surprising if the slowdown were limited to declines in total factor productivity alone.

Since the Department of Finance study finds no other significant factor, it leaves a substantial portion of the decline unexplained. In summary, its authors believe that the sharp falloff in the energy sector and a slowdown in the growth of the capital-to-labour ratio account for roughly one-half of the productivity growth decline.[4]

Other Canadian evidence

The breadth of the decline in Canadian productivity can be substantiated by referring to Table 4, adapted from Denny, Fuss and May (1981). It presents the average rates of growth of total factor productivity for 1961

4 We have avoided quoting the detailed numbers since they are more controversial.

TABLE 4
The productivity slowdown in regional Canadian manufacturing, 1961-75 (average annual growth in total factor productivity)

	Atlantic provinces	Quebec	Ontario	Prairies	BC	Rest of Canada
Food and beverages						
1961-70	+1.12	+1.34	+1.37	+0.94	+1.20	-
1970-75	+0.66	+0.46	+0.47	+0.32	+0.51	-
Textiles						
1961-70	+2.75	+2.23	+2.33	+1.55	+2.11	-
1970-75	+1.88	+1.63	+1.98	+2.19	+2.17	-
Clothing						
1961-70	-	+0.98	+0.80	-	+0.87	+0.77
1970-75	-	+0.98	+0.88	-	+0.82	+1.06
Wood						
1961-70	+1.50	+1.45	+1.36	+1.57	+1.30	-
1970-75	-0.17	-0.25	-0.34	-0.28	-0.37	-
Paper						
1961-70	-	+2.12	+2.00	-	+2.36	+1.98
1970-75	-	-1.21	-1.26	-	-1.34	-1.30
Machinery						
1961-70	-	+1.81	+1.66	+1.21	+1.91	-
1970-75	-	+2.04	+2.41	+1.79	+2.32	-
Transportation						
1961-70	-	+2.77	+2.16	-	+3.25	+3.25
1970-75	-	+1.27	+0.71	-	+1.39	+1.80
Nonmetallic minerals						
1961-70	+1.55	+1.62	+1.59	+1.62	+1.11	-
1970-75	+1.51	+0.66	+0.30	+0.42	+0.51	-
Petroleum and coal						
1961-70	-	+1.49	+1.46	-	-	+1.91
1970-75	-	-0.03	-0.13	-	-	-0.04
Chemical products						
1961-70	+2.26	+2.89	+3.21	+3.24	-3.08	-
1970-75	+3.11	+1.13	+1.71	+1.69	+1.46	-

NOTE: For some industries, regional data were not available; the residual 'Rest of Canada' heading covers activity in that industry not shown separately in one of the other regions.
SOURCE: Denny, May, and Fuss (1981)

to 1970 and 1970 to 1975 for ten major manufacturing industries in five Canadian regions.

For 80 per cent of the regional industries shown, productivity fell during the 1970s. Wood, paper, transportation equipment, and petroleum and coal products suffered severe declines. Textiles, clothing, and machinery, however, had increases or declines that were small compared to those in most industries. This evidence reinforces our belief that although the breadth and depth of the productivity declines are very large, there remains a significant, if small, portion of the economy that has continued to have improvements in productivity matching or surpassing the results achieved during the 1960s. It is unfortunate that no study has attempted to look at those cases in which productivity growth did not slow perceptibly. (The Canadian regional data would be suitable for this task, and there are no regional data available in the United States.)

The Canadian material suggests that the magnitude of the slowdown is more concentrated by industry than by region. That is, certain industries, regardless of region, have experienced significantly large or small productivity slowdowns. For example, about one-quarter of the regional industries had relatively modest productivity declines in the 1970s; two-thirds of these cases occurred in only one-quarter of the industries.

This industrial concentration does not obviate the fact that some regions have suffered from the slowdown to a greater extent than others. As we shall see in detail in a later section, Ontario and British Columbia have suffered the sharpest overall declines and the Atlantic region the slightest. Differences in the regions' industrial structures account for much of this variation in impact. Manufacturing in Ontario and British Columbia is more heavily concentrated in industries that have had severe productivity declines than it is in other regions. As one can see from Table 4, it is not the poor performance of individual industrial sectors in Ontario relative to the same sectors in other regions that is the main factor in the overall poor performance of Ontario's manufacturing; rather, it is the fact that the poorly performing industries concentrate their activities in Ontario.

Summary

This completes our survey of the small number of studies relating to the

Canadian productivity slowdown. They indicate the limited understanding of this phenomenon. In the next section, we shall consider the more extensive studies of the U.S. situation.

The U.S. economy

The Great Productivity Slowdown in the United States has generated a much larger number of studies and a broader public debate than it has in Canada. Since the slowdown is a world-wide phenomenon, the American evidence may improve our understanding of the Canadian situation.

An overview of the U.S. experience is given in Table 5. For the U.S. domestic business economy, total factor productivity grew at an annual rate of 2.7 per cent during 1948 to 1966, then fell to rates of 1.6 per cent during 1966 to 1973 and 0.8 per cent during 1973 to 1978. Productivity growth had slowed even by the late 1960s, and it plunged during the mid-1970s.

During the first two periods, output growth was relatively high - 3.9 per cent and 3.5 per cent a year respectively. Only during the final period did it decline substantially. It is this decline that has led to an investigation of the cyclical nature of the productivity growth rate slowdown.

On the input side, the growth rate of labour has shown a distinct acceleration since 1965. This rise is a consequence of the high birth rates of the postwar period. The high growth rate of the labour force and employment during 1965 to 1973 and 1973 to 1978 was not, however, accompanied by an accelerated growth of output; in consequence, labour productivity fell sharply. The economy was absorbing the swift increase in workers, although it was not able to raise the output growth rate sufficiently to maintain the growth rate of labour productivity.

The growth rate of capital also accelerated during the two later periods but not as quickly as the labour input. Hence, factor-intensity growth's contribution to labour productivity fell during each of the later two periods. The growth in the capital input was not sufficiently swift to continue the growth in the capital-to-labour ratio experienced in 1948 to 1966.

The combination of these patterns resulted in the miserable slide in the growth rate of total factor productivity.

In the United States, as in Canada and other industrialized countries,

TABLE 5
Productivity and growth in the United States domestic business economy, 1948-78 (average annual percentages)

	1948-66	1966-73	1973-8
Output	3.9	3.5	2.4
Factor input, total	1.2	1.9	1.6
Labour	0.4	1.4	1.3
Capital	2.7	3.3	2.3
Labour productivity	3.5	2.1	1.1
Factor intensity	0.8	0.5	0.3
Total factor productivity	2.7	1.6	0.8

SOURCE: Kendrick (1980a, table 8)

the productivity growth decline was not limited to a small segment of the economy but occurred in almost all sectors. Table 6 shows examples of the patterns of labour productivity growth in the major sectors of the American economy. No regional studies are available for the U.S., but it would be very surprising if one did not reveal a general pattern of declines with some increases.

Attempts to explain the sources of the productivity slowdown in the U.S. have been numerous. We will concentrate on a limited number of major studies and refer in passing to many other investigations.

Two major U.S. studies

A review of Denison's (1979) and Kendrick's (1980a) studies makes a good starting point because these two authors have been major contributors to the literature on American productivity. Denison, using the growth accounting framework he developed earlier (1962, 1967, 1974), attempts to explain the decline in labour productivity measured as national income per person employed in the U.S. nonresidential business sector. The major sources he investigated are summarized in Table 7.

Having defined productivity in terms of employment, Denison relates his first source to the characteristics of labour. The net effect for changes in hours worked, age-sex composition, and education is very small - 0.1 per cent - in both periods. A positive contribution from education eliminates the negative impact of reductions in hours worked and of changes in the sex-age composition of the labour force.

TABLE 6
Rate of growth of labour productivity by sector: United States (average annual percentages)

	1948-57	1957-68	1968-73	1973-79
Manufacturing	2.57	2.84	2.72	1.41
Agriculture	5.58	4.76	5.12	2.81
Construction	2.50	2.98	-5.15	-2.49
Utilities	6.78	5.16	3.19	-0.66
Services	1.19	1.82	2.01	0.14

SOURCE: Baily (1981, table 3)

According to Denison, changes in factor intensity, resource allocation, the legal environment, and economies of scale combined to contribute 1.2 per cent to the growth of U.S. labour productivity from 1948 to 1973 but made no contribution from 1973 to 1976. The capital-to-labour ratio did not grow as quickly during the latter period, reducing the factor-intensity component. The reallocation of resources (which predominantly involves shifting resources out of agriculture and other low-productivity sectors) contributed nothing during 1973 to 1976. The final two items involve more controversial measures. Denison estimates that a more restrictive 'legal environment' (that is, more restricted by legislation) had a negative impact during the later period, as did economies.

In brief, Denison attributes to these four factors a 1.2 per cent decline - about one-third of his 3.2 per cent total. But since labour characteristics contribute a positive 0.1 per cent to his calculations, the net effect of his allocation is only a 1.1 per cent decline. This leaves his residual to fall from 1.4 per cent in the 1948 to 1973 period to -0.7 per cent during 1973 to 1976. Since this residual is supposed to include advances in knowledge, its sign and size is perplexing.

Kendrick (1980a) presents a similar exercise on the U.S. domestic business sector, attempting to explain the declines in total factor productivity. Some of his estimates differ from Denison's, but there is very little difference in the overall impact, as shown in Table 5. Kendrick introduces explicit estimates of the contribution of advances in knowledge, figures that fall sharply over time. Resource allocation, the legal environ-

TABLE 7
Sources of growth of labour productivity, U.S. nonresidential business sector (average annual percentages)

	1948-73	1973-76
Labour productivity growth	2.4	-0.5
Adjusted labour productivity growth	2.6	-0.6
Labour characteristics		
Hours	-0.2	-0.5
Age-sex composition	-0.2	-0.3
Education	0.5	0.9
Factor intensity	0.4	0.2
Resource allocation	0.4	0.0
Legal environment	0.0	-0.4
Economies of scale	0.4	0.2
Residual	1.4	-0.7

SOURCE: Denison (1979, table 1-1)

ment, and scale economies contributed a 1.2 per cent growth in 1948 to 1966 and 0.2 per cent in 1973 to 1978, according to his calculations.

For the particular time period and the sector of the economy that Kendrick has chosen, his results do not show a major decline in the residual component over time. This finding might appear to eliminate the perplexity of Denison's findings. However, we believe that Kendrick's use of a later cutoff year contributes substantially to the difference in the two researchers' results. Perhaps more important is the fact that the attempt to allocate productivity to specific sources proved a very difficult task for both men. Consequently, the uncertainties surrounding the magnitudes of many of their estimates lead us to view the seemingly large difference in their residuals with caution. Without accepting their empirical magnitudes, we might conclude that the two authors view the importance of the various sources of the decline in very similar ways. In addition, Kendrick has developed estimates that quantify the decline in the growth of knowledge and do not leave a large unexplained change in the residual during the slowdown period.

In addition to the various factors listed in Tables 5 to 7, many other factors have been suggested as having played a part in the Great Productivity Slowdown. To illustrate, Table 8 lists seventeen alternative factors that Denison tentatively investigated in his study (1979). He

TABLE 8
Denison's catalogue of possible additional causative factors in productivity slowdown

- Curtailment of expenditure on research and development
- Decline in opportunities for new advances
- Decline of Yankee ingenuity and deterioration of American technology
- Increased lag in the application of knowledge because of the ageing of capital
- Diversion of inputs to comply with government regulations
- Government-imposed paperwork
- Regulation and taxation: drains on executive time
- Government regulation: delay of new projects
- Regulation and taxation: misallocation of resources
- Effects of high tax rates on incentives and efficiency
- Capital gains provisions of the Revenue Act of 1969
- 'People don't want to work anymore'
- Impairment of efficiency by inflation
- Lessening of competitive pressure and changes in the quality of management
- The rise in energy prices
- The shift to services and other structural changes
- Possible errors in the data

SOURCE: Denison (1979, chap. 9)

concluded that many had not been intensively studied by anyone but that it seemed unlikely that any very small subset of them would be adequate to explain the productivity slowdown.

Studies of alternative determinants

Both of Denison's conclusions still hold true in the U.S. and Canada today. It seems worthwhile, however, to consider evidence suggested by several other authors on the role of labour services, the energy crisis, and the capital-to-output ratio in the decline in productivity.

Labour quality

The most detailed studies of changes in labour quality and the resulting changes in productivity are those of Chinloy (1979, 1980). Table 9 gives a brief summary of his views. Labour quality is measured by age, sex, occupation, employed versus self-employed status, and educational attainment. Changes in these five characteristics of the workers in the U.S. economy are evaluated both separately and through interactive effects to estimate the growth in labour quality. Labour productivity is measured as

TABLE 9
Labour productivity growth: U.S. private sector, 1947-74

	1947-67	1967-71	1971-4
Labour productivity	2.991	2.134	0.649
Total factor productivity	1.182	0.234	-0.128
Labour quality	0.445	0.335	0.075
Factor intensity	1.363	1.565	0.702

SOURCE: Adapted from Chinloy (1979, 1980)

output per manhour.

Using these measures, Chinloy finds that from 1947 to 1967, labour-quality growth contributed about 15 per cent of the increase in labour productivity. This growth dropped during the next period, but its percentage contribution did not, since labour productivity fell even more sharply. The sharp decline in labour productivity was mostly the result of a disastrous drop in total factor productivity, which continued to fall during 1971 to 1974. (This is, of course, Denison's story for the same period.) The 1971 to 1974 decline in labour productivity resulted primarily from the collapse of factor-intensity growth, secondarily from that further decline in total factor production, and finally from the slow growth of labour quality.

In the United States, there is fairly widespread agreement with Chinloy's conclusion that declines in the quality of labour services are significant but not a major determinant of the decline. Explanations focussed on narrow aspects of labour quality are even less likely. The rapid increase in young and female workers has contributed to slower productivity growth (because of their inexperience) but not in any serious fashion. Moreover, the negative effects on labour quality will be partially reversed with time as these workers gain experience. These conclusions are consistent with those of the Canadian Department of Finance study (Canada 1980).

The energy crisis

The energy crisis is often thought to be a leading factor in the productivity slowdown. Jorgenson and Fraumeni (1981) and Fraumeni and Jorgenson (1981) provide the most ambitious attempt to assess the impact

of higher energy prices on productivity growth. They estimated the parameters of an econometric model of producer decisions for a multi-sectoral model of the U.S. economy. Their results imply that in almost all sectors a sharp rise in energy prices results in a sharp drop in the rate of technical change, which they assume equals the rate of growth of productivity.

We believe, however, that their results require further investigation before being accepted. Denny, Fuss, and Waverman (1979) have constructed a model of Canadian manufacturing that is quite similar to the Jorgenson-Fraumeni model. As Waverman (1980) has discussed, the Canadian results do not support the U.S. results; the impact of higher energy prices on technical change is much less uniform in the Canadian estimates. And none of the studies has been able to provide linkages between rising energy prices and falling productivity that are explicit enough to permit adequate quantitative measures of the impact.

The capital-to-labour ratio

The role of changes in the flow of capital services in explaining the productivity slowdown is the subject of some of the most interesting recent studies in the area (for example, Baily [1981]; Berndt and Fuss [1981]). Capital enters the explanation of the decline of labour productivity through changes in the capital-to-labour ratio. As we have seen, although both Canadian and U.S. studies do assign importance to recent slowdowns in the growth of the capital-to-labour ratio, most regard the drop in the growth of total factor productivity as playing a larger role in explaining the decline in labour productivity growth. In contrast to analysts such as Kendrick, however, Baily attributes a comparatively large portion of the decline to a drop in the quantity of capital services. His claim is that others have substantially overestimated the volume of the rate of growth of capital services. This theory implies that the decline in the growth of the capital-to-labour ratio has been severely underestimated. Thus, according to Baily, total factor productivity has not declined very much during the recent period; the capital-service flow, measured by his standard, has dropped off considerably.

Berndt and Fuss, on the other hand, concentrate on what they believe to be an overestimate of the cost share of capital inputs. Their analysis, like Baily's, results in the conclusion that total factor product-

ivity has not declined as much as conventional measurement suggests. However, the magnitude of their upward adjustment is not as great as Baily's.

Those authors attribute the decline in capital services to obsolescence brought on by rapid shifts in the prices of inputs or outputs. Baily's major examples are the rapid increase in energy prices and the sharp shifts in product mix brought about by increased U.S. trade participation. The core of the argument assumes that the existing capital stock was designed with relatively little flexibility for its use. If this hypothesis is true, then sharp unexpected shocks lead to the stock's obsolescence and early scrapping, relative to expectations.

It also may imply, as Berndt and Fuss suggest, that the capital stock may be used less intensively and that its market value will decline sharply.[5]

To the extent that these arguments are correct, they mean that other estimates of productivity have overestimated the quantity of capital services and their weighted contribution to the growth of aggregate input. Some part of the apparent decline in productivity becomes an error in measurement; there may be little, if any, true productivity decline. It is too early to evaluate the theoretical or empirical importance of this analysis. However, it is certainly a theory with suff.cient credibility and bits of supporting empirical evidence to merit much more intensive investigation.

Summary and policy proposals

The Great Productivity Slowdown is a world-wide empirical phenomenon that has eluded researchers' attempts to provide a complete and convincing explanation. Since we are interested in evaluating the performance of economic units, continued efforts must be devoted to clarifying what complex of factors has resulted in the observed slowdown or whether our current measures are seriously in error. Simple explanations will certainly be inadequate for a phenomenon that, although widespread, shows extensive diversity in detail.

5 One of the bits of evidence used to support this type of argument are observations on the decline in stock market valuations of the industrial capital stock.

Given our limited understanding of the evidence, no concrete policy response is likely to deserve or receive wide-spread support. Kendrick (1980b) has argued for a whole menu of policy responses that would promote research and development, increase the profitability of faster scrapping of older plants, and improve the quality of labour. It seems to us, however, that although new, improved plants operating with higher-quality labour could certainly increase efficiency in specific cases, the exact relationship between government policy, which has costs, and the benefits derived from business response are tenuous and often quantitatively unknown. Hence, present evidence seems insufficient to justify a costly, large-scale policy program for raising productivity growth. We simply do not know enough about how to do it in a fashion that would ensure the results justifying the cost.

For almost a decade, productivity growth has been slower than the average growth during the previous eighty years. A cautious forecast suggests that we can expect productivity growth to return gradually to a higher level. If it does not, then we will be confronted with a major historical break that requires an explanation. At the moment, we have no simple concise explanation of the current slowdown, let alone of a hypothetical major break.

6
INTERNATIONAL COMPARISONS

In a fine survey on international comparisons, Kravis states, 'Comparisons of productivity go to the heart of the assessment of economic performance' (1976, p. 11). The comparisons with which he is concerned are cross-sectional comparisons of different geographical regions, which are less common than intertemporal comparisons. They are, however, much to the point, particularly in a Canadian study. Like most Canadian analysts, we intend to concentrate on comparisons of Canada with the United States. First, however, some broader points must be made.

Logically, there is no reason to distinguish intertemporal and international or interregional productivity comparisons. Both use some standard measure to compare output per unit of input, and one can use the production function to assist in the conceptual and empirical division of productivity into components for the comparison.

Empirically, however, international comparisons entail differences and problems of some importance. First, reliable information from other countries can be difficult to obtain, a fact that has led to the use of particular methods. Second, international comparisons require adjustments of data to a common currency. (The use of exchange-rate data is often inappropriate.) Third, the comparability of inputs and outputs is less and the variation in their prices and quantities larger for international or interregional comparisons than for intertemporal comparisons.

Given these problems, researchers making international comparisons have tended to use labour productivity figures in which output is measured as real value-added or net output. Yet, as we explained earlier, net-output measures present some difficulties, and we prefer the use of gross output, with its more complete list of inputs.

Studies of several countries

To provide a sample of recent international comparisons, we will outline the work of Christensen, Cummings, and Jorgenson (1980a, 1980b), and Kravis et al. (1975, 1978a, 1978b), as well as a United Nations project, before examining some studies specifically contrasting Canada and the United States.

Christensen, Cummings, and Jorgenson (1980a, 1980b) constructed comparable aggregate data for the postwar period in a number of countries. Tables 10 and 11 report some of their results for Canada, the United States, the United Kingdom, West Germany, and Japan.

Table 10 illustrates the range of growth rates during two subperiods since the Second World War. In the one before 1960, Canada's real output grew at slightly more than 5 per cent a year, a rise accomplished with a rapid input growth rate of 3.5 per cent and a growth in total factor productivity of 1.7 per cent. The 1960 to 1973 results are similar with two exceptions: capital accumulation was at a much lower rate and labour input growth was at a much higher one.

Relative to the United States', Canada's output and input growth were large for both periods. The percentage differential in the productivity growth rate was sizeable, although the absolute differential was not huge. Overall, the two countries had similar patterns of faster labour and slower capital input growth during the second period. Canada's performance was better, but not by a very large margin.

The results for Canada and the U.S. are quite different from those for the U.K., West Germany, and Japan. The latter two, particularly Japan, had very high rates of output growth in both periods. Japan achieved this through a spectacular rate of growth of labour input during the first period and a spectacular rate of growth of capital during the second. During both periods, the growth in productivity was very high.

West Germany's performance was also superior to Canada's by a substantial margin during both periods. Productivity grew at an average rate approximately double Canada's. Germany's labour input had a negative rate of growth during the second period, but this slowdown was offset by a continuation of the rapid capital accumulation of the first period.

The United Kingdom, on the other hand, had the slowest rates of growth of inputs and outputs during both periods. This did not prevent

TABLE 10
Aggregate performance indicators for Canada and selected countries in the postwar period (average annual rates of growth, percentages)

	1947-60	1947-60	1955-60	1950-60	1952-60
	Canada	U.S.	U.K.	Germany	Japan
Real output	5.2	3.6	3.3	8.2	8.1
Real input	3.5	2.5	1.8	3.6	4.7
Total factor productivity	1.7	1.1	1.5	4.7	3.4
Capital	6.8	4.6	4.5	6.9	4.5
Labour	1.1	1.2	0.2	1.6	4.8
	1960-73				
Real output	5.1	4.1	3.8	5.4	10.9
Real input	3.3	2.9	1.8	2.4	6.4
Total factor productivity	1.8	1.1	2.1	3.0	4.5
Capital	4.9	4.0	4.6	7.0	11.5
Labour	2.0	2.2	0.0	-0.7	2.7

SOURCE: Christensen, Cummings, and Jorgenson (1980a)

its productivity from growing at rates that roughly equalled Canada's and exceeded the United States'. Its labour input grew very little throughout the first period and not at all during the second. In fact, during the second period, it was slow labour growth that separated West Germany and the U.K. from Canada, Japan, and the U.S.

In making international comparisons, we are often interested in rates of growth and relative levels of productivity at different times. Table 11 reports Christensen, Cummings, and Jorgenson's findings on annual levels of total factor productivity for Canada, the U.K., West Germany, and Japan, relative to the U.S. In 1973, Canada and West Germany had roughly equal productivity levels, 10 per cent lower than that of the U.S.; Japan and the U.K. had equal productivity levels that were approximately 25 per cent below the U.S.'s.

Notice, however, that over the postwar period, all these countries reduced the size of their productivity differentials with the United States. The U.K. and Canada did not make huge relative increases, but West Germany and Japan partially closed very large gaps. The U.K. gained

TABLE 11
Total factor productivity relative to United States (U.S. = 100.0 in each year)

	Canada	UK	Germany	Japan
1950	82.0	--	46.2	--
1951	80.4	--	49.3	--
1952	84.0	--	52.2	41.0
1953	84.1	--	53.1	42.4
1954	81.7	--	57.1	44.6
1955	83.2	66.8	60.9	44.9
1956	87.6	67.3	63.1	47.4
1957	85.9	68.7	65.2	48.5
1958	86.0	68.6	66.0	47.6
1959	84.1	67.8	68.1	49.2
1960	84.3	70.0	73.7	53.8
1961	83.8	70.1	74.8	58.9
1962	83.6	67.7	74.2	55.3
1963	84.6	67.7	74.0	58.3
1964	85.1	68.9	76.8	61.4
1965	85.9	67.7	78.5	60.4
1966	86.4	67.8	77.0	62.3
1967	85.9	69.9	75.2	65.8
1968	87.3	70.6	81.0	70.6
1969	86.8	70.4	86.9	73.5
1970	91.4	74.2	90.9	77.8
1971	91.6	76.9	90.0	77.1
1972	90.9	77.0	89.2	77.8
1973	90.7	77.5	90.6	78.0

SOURCE: Christensen, Cummings, and Jorgenson (1980b)

very slightly on Canada but fell relative to West Germany and Japan.[6]

6 Relative to a larger group of developed countries, Canada's performance has been above average. The high-performance countries, such as West Germany and Japan, have substantially outperformed it,

The Christensen, Cummings, and Jorgenson international comparison is unique in its use of (1) total factor productivity, and (2) the methodology initially developed by Jorgenson and Nishimizu (1978) for comparing productivity levels. The study makes it easy to compare growth rates of labour productivity; using the data in Table 10, one simply calculates the difference between the growth rates of output and labour. It is not possible, however, to assess differences in labour productivity levels without access to the original data.[7]

The United Nations project

The United Nations has sponsored a large study of international comparisons, which has resulted in major reports by Kravis et al (1975) and Kravis, Heston, and Summers (1978a) as well as a number of journal papers (for example, Kravis, Heston, and Summers [1978b] and Summers, Kravis, and Heston [1980]). The UN project is the most important single attempt to evaluate the differences in productivity and real incomes across many countries.

Space does not permit a description of the empirical results of the UN studies, but some comments on the methodological choices are in order. The studies define productivity as output per employee, the choice of labour productivity as a measure being based primarily on the severe difficulties of obtaining information on other inputs in most countries in the world. And because of the very wide dispersion of products produced and consumed across the world, the researchers emphasize collecting detailed prices for quite specific outputs. Purchasing power price indexes are calculated as geometric averages of specific relative prices between countries. (Most but not all of the averages are unweighted.) Aggregate relative prices are used to deflate expenditure data and thus provide estimates of real output. Notice that the methods chosen for this project

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but most countries have been fortunate to have performed as well as Canada.

7 At the moment, there are no disaggregated studies that use the newer methodology to compare Canadian industries with those in other countries. Most of the existing disaggregated studies concentrate on labour productivity with some references to total factor productivity. When total factor productivity is used, it tends to be real value-added total factor productivity rather than gross output, creating the problems already noted.

are more compatible with the noneconomic approach to index number theory than with the economic one.

The UN project is unique in its scope. A substantial empirical literature has developed in Europe comparing productivity levels of European countries. (Kravis [1976] gives some examples.) These studies are relatively independent of North American work. Closer collaboration might clarify whether the distinctly different approaches in Europe can be reconciled satisfactorily with North American studies.

Canadian - U.S. comparisons

Comparisons of U.S. and Canadian productivity growth and levels are not new. The late 1960s saw a flurry of research activity on productivity, much of it sponsored by the Economic Council of Canada (for example, West [1971], Walters [1968, 1970], Auer [1969], Daly, Keys, and Spence [1968], and Postner [1971]. Although these studies were not all concerned with comparisons between Canada and the United States, many used the U.S. as a measuring stick for Canadian performance.

A number of Canadian studies have adopted the growth accounting framework developed by Denison (1962, 1967). These investigations resulted in the publications by Walters (1968, 1970) and Daly and Walters (1967). These authors found that net national income per employed person in Canada was at least 20 per cent lower than in the United States.

Canada and U.S. manufacturing

Frank recently undertook a detailed comparison of labour productivity in Canadian and U.S. manufacturing. His study (1977), sponsored by the Conference Board of Canada, investigates Canadian industries' changing competitive position, with productivity levels being one component. His methodology involves the evaluation of value-added for a particular industry and time period in the prices of both countries.

Table 12 presents a summary of Frank's major findings for 1967 and 1974. The first two columns show the results when Canadian prices are used in both countries to calculate value-added. The third and fourth columns contain the estimates using American prices. There are several intriguing results. First, in a very short period of time, Canada's relative labour productivity improved very sharply in most industries for

TABLE 12
Relative labour productivity levels (Canada's labour productivity as a percentage of United States')

	Canadian prices		American prices	
	1967	1974	1967	1974
Nondurable goods	53	68	61	70
Food processing	72	69	73	78
Textiles, clothing	70	83	90	90
Paper products	76	77	99	88
Petroleum refining	37	70	25	55
Miscellaneous	44	53	29	50
Durable goods	73	94	70	98
Wood products	111	117	117	147
Metal products	70	93	71	96
Motor vehicles	77	100	61	93
Miscellaneous	60	68	60	65

SOURCE: Frank (1977, p. 66, table 9)

both sets of prices. Second, performance in the Canadian durable goods industries was superior to that in nondurable goods. Third, Frank's more detailed results for thirty-three manufacturing industries indicate a very wide dispersion of both gains and losses in Canada's relative labour productivity levels.

We would very much like to see this study extended because these findings are surprising in their magnitudes. For example, although the relative gain in Canada's labour productivity is undoubted, Frank's magnitudes seem too large for many industries. A study using a longer time period might clarify why these sharp changes occurred. Similarly, the relatively better performance by durable goods in Canada is primarily the result of their very rapid gains from 1967 to 1974. A longer study might reveal that this rapid change was caused by some particular characteristics of the time period and that the difference between the two kinds of industries has since lessened. Nevertheless, we agree that Canada's performance was improving in many industries during this period. In general, Frank's results confirm the finding of other studies: Canada's manufacturing sector has had a higher labour productivity growth rate than the United States'. Undoubtedly, our labour productivity level is lower; exactly how much lower may be relatively imprecisely known.

A curious fact, noted in Frank's study and elsewhere, is the higher capital-to-labour ratio in Canadian manufacturing. This is an observation

that needs much more careful investigation than it has received. It seems likely that measurement problems have created at least part of this odd outcome. Yet since no hard evidence is currently available, everyone has tended to accept the observed results. If they are correct, the two countries' total factor productivity levels must be farther apart than their labour productivity levels. And certainly total factor productivity has been growing faster in Canadian manufacturing than in American during most of the postwar period. However, we would like to see a more careful calculation of the levels and an investigation of reasons for the observed capital-to-labour ratio differentials.

Structural and behavioural variables

Several other studies of relative levels of Canadian and U.S. productivity have attempted to measure the significance of a number of structural and behavioural variables. Underlying them is a combination of industrial organization and international trade theory, a framework that belongs to a strand of Canadian economic research exemplified by Eastman and Stykolt (1967) and more recently by Caves et al (1980). The empirical investigations attempt to measure the impact of such factors as tariffs, scale, concentration, and product diversification on relative labour productivity in Canadian and American manufacturing. Two such studies have been done recently by Saunders (1980) and Bernhardt (1981), extending earlier work by West (1971), Postner (1971), and Fowler (1976).

Saunders (1980) is primarily interested in the effect of protective tariffs on inefficiently small industries. Using a sample of eighty-four manufacturing industries, he finds that the productivity differential is larger where effective protection provides a survival shield for small-scale Canadian industries. His results also suggest that higher proportions of foreign ownership in Canadian manufacturing are associated with lower relative productivity levels, although he offers no adequate explanation for this phenomenon. In addition, he tests but finds no strong support for a number of other hypotheses, including the influence of imports, of research and development, and of concentration.

Bernhardt (1981) addresses the same set of issues within a similar framework. His data and estimated equations are, however, different, and he unfortunately includes no recognition of Saunders' results. Surprisingly, Bernhardt finds that neither effective tariffs nor capital-to-labour

ratios explain labour productivity differentials between Canada and the U.S. The former finding conflicts with Saunders' results, although the latter is consistent with them. Since the two researchers' models are quite different, only further empirical work could pin down the reasons for the variation in their findings. Bernhardt's results certainly suggest that the relative size of the two national markets is an important determinant of relative labour productivity levels and the changes in these levels between 1963 and 1972.

Summary

In brief, empirical attempts to isolate the relative impacts of a variety of possible determinants of productivity differentials between Canadian and American industries have only been partially successful. Certainly, this work is important and requires further efforts to clarify what might be done to eliminate the disadvantage in Canadian productivity.

7

INTER-REGIONAL COMPARISONS

Since pre-Confederation days, Canadians have been fascinated by the variations in the country's regions and the forces that determine regional differences. Strong political and financial convictions often ride on beliefs - in facts and in myths - about their causes. Certainly, regional per-capita income differentials have lasted over long time periods, but we have only a mixed understanding of the processes that have maintained these phenomena. Many popular myths award substantial responsibility either to government policy or to different regional work ethics. Yet the evidence for these hypotheses is very weak. Around the world, government economic policies have not tended to rescue regions from the fates handed them by market forces, geography, and history. Substantial income transfers may reduce income disparities and create demands for regional products, but such policies do not appear to alter market forces sharply.

At a broad level, we know that geographical patterns and the spatial distribution of market opportunities create larger spatial economic rents in some regions than in others. Our understanding of precisely how these processes operate is probably quite limited; however, there is no doubt that productivity differentials are an important aspect of per-capita income differentials. Real regional per-capita income can be viewed as the product of three ratios: labour productivity, Q/L; the actual relative to the potential work force, L/PL^{8}; and the potential work force relative to the population, PL/P.[9] Regional variations in per-capita income depend on differentials in all three ratios.

8 The determinants of this ratio are quite complex since they include not only the measured unemployed but also potential workers who have chosen not to enter the measured labour force.

9 This ratio captures the consequences of the age distribution of the regional population. Children and many older people are often economically inactive.

Auer's interregional study

The most recent comprehensive investigation of Canadian regional inequalities was done by Auer (1979) and first published as part of the Economic Council of Canada's report Living Together (1977). Table 13 shows some of his findings. The first and second columns present his evidence on income per capita compared to income per worker from 1970 to 1973. The four provinces with the highest incomes per worker have even higher incomes per capita. At the other extreme, in three of the four provinces with the lowest incomes per worker, the incomes per capita are substantially lower. That is, the dispersion of income per capita is much larger than the dispersion of income per worker. A related phenomena occurs in the labour productivity series: the dispersion in regional labour productivity in the goods sector is wider than the dispersion in the total economy. Data problems in the service sector are partially responsible for this spread, but the service sector has fewer possibilities for interprovincial trade that might benefit from scale economies.

Auer's findings show sharp differences in some provincial rankings when the measure shifts from income per worker to labour productivity. Value-added, the output measure used in the third column, differs from income in a province due to ownership or the purchase of some business services outside that province. The net effect is strongly negative in Newfoundland, Saskatchewan, and Alberta, where the relative income per worker is much lower than relative labour productivity. Ontario and Nova Scotia are the only provinces in which income per worker is substantially above labour productivity. These variations remind us that national and domestic incomes can be very different in open economies.

Auer also studied the impact of a number of factors on labour productivity. We have summarized some of his results in Table 14, a complex table that can best be discussed by considering the results for one province, for example for the total economy of Newfoundland. Each entry in the table answers a specific question, with the answer stated as the percentage difference between the answers for a particular province and for all Canada. For example, looking at the first entry in the Newfoundland line, we see that the province's labour productivity was 9 per cent lower than the national economy's. Continuing across, the second column indicates that the particular industrial structure (industry mix) in Newfoundland raised labour productivity by 6 per cent relative to the

TABLE 13
Income and productivity levels, Canadian provinces, 1970-3 (all Canada = 100)

	Income		Labour productivity	
	Per capita	Per worker	Total economy	Goods
Newfoundland	54	78	91	81
Prince Edward Island	60	--	60	46
Nova Scotia	75	87	77	70
New Brunswick	68	82	82	73
Quebec	88	92	93	86
Ontario	119	110	104	107
Manitoba	94	92	89	82
Saskatchewan	80	83	99	91
Alberta	99	95	114	130
British Columbia	110	108	110	115

NOTE: The figures are averaged over annual data for 1970-3, with the value for all-Canada normalized to 100 in each case. The income variable excludes government transfers. Output for productivity is measured as census value-added, and the estimates of employment are not consistent.
SOURCE: Auer (1979, p. 6, table 1-1)

industry structure in all Canada. Consequently, in the third column, where labour productivity is adjusted to eliminate the effects of industrial structure, Newfoundland's labour productivity is 15 per cent lower than the Canadian national economy's.

Labour productivity depends on both the other resources made available to workers and the quality of the workers themselves. The fourth and fifth columns show that in Newfoundland, the capital stock per worker has no effect on relative labour productivity, but the quality of the workers has a -6 per cent effect. The last column presents data on relative labour productivity after adjusting for industrial structure, capital per worker, and labour quality.

The broad patterns revealed by Table 14 are interesting. For the total economies, industrial structure has a major impact on labour productivity only in Prince Edward Island and Saskatchewan. Labour quality has a relatively minor role everywhere, although its effects are positive in

TABLE 14
Variations in regional labour productivity: the role of industry structure, capital intensity and labour quality

	Labour productivity	Industry structure	Adjusted labour productivity	Capital labour	Labour quality	Residual labour productivity
Total Economy						
Newfoundland	- 9	+ 6	-15	0	-6	- 9
Prince Edward Island	-40	-16	-24	-14	-4	- 6
Nova Scotia	-23	- 1	-22	- 5	-2	-15
New Brunswick	-18	+ 1	-19	- 3	-4	-12
Quebec	- 7	+ 1	- 8	- 6	-3	+ 1
Ontario	+ 4	+ 1	+ 3	- 3	+1	+ 5
Manitoba	-11	- 3	- 8	- 2	-2	- 4
Saskatchewan	- 1	-12	+11	+13	-1	- 1
Alberta	+14	- 4	+18	+16	+3	- 1
British Columbia	+10	+ 1	+ 9	+ 9	+6	- 6
Manufacturing						
Newfoundland	-22	+ 2	-24	+69	-3	-90
Prince Edward Island	-33	+ 2	-35	-24	-6	- 5
Nova Scotia	-26	+ 1	-27	+28	+4	-59
New Brunswick	-21	- 1	-20	+70	-4	-86
Quebec	-13	- 6	- 7	- 7	-1	+ 1
Ontario	+ 9	+ 3	+ 6	+ 1	0	+ 5
Manitoba	-19	- 8	-11	+ 8	-1	-18
Saskatchewan	+ 8	+ 2	+ 6	+28	-2	-20
Alberta	+ 6	+ 2	+ 4	+ 7	+4	- 7
British Columbia	+ 9	0	+ 9	+ 6	+6	- 3

SOURCE: Auer (1979, tables 3-3 and 3-7)

most of the West and negative in much of the East. Capital per worker has a significant effect on productivity, increasing it in most of the West and lowering it in the East. The effect of removing the combined influence of capital per worker and labour quality is to improve relative labour productivity substantially in the East and lower it substantially in the West; the results listed under 'Residual labour productivity' are much less dispersed than the results under 'Adjusted labour productivity'.

The residual labour productivity figures can be interpreted as real value-added versions of total factor productivity in which labour has been adjusted for quality. In that sense, Auer's results are consistent with others, described later in this section, that suggest regional total factor productivity differentials are much smaller than regional labour productivity differentials.

Auer's evidence on regional manufacturing will not be discussed here in any detail. As the reader can observe in Table 14, he comes to many of the same general conclusions as he does for the provinces' total economies. The major oddity is the very large effects of capital per worker in the Atlantic provinces. These results conflict with our own work in manufacturing (Denny and Fuss [1981]).

Authors' interregional studies

The authors have participated in a number of studies of regional manufacturing productivity. In Denny and Fuss (1980) and Denny, Fuss, and May (1981), we attempt to assess the levels and changes in regional total factor productivity in total manufacturing and in twenty manufacturing industries from 1961 to 1977. We were interested in using the newly developed techniques for interpreting and measuring regional productivity to evaluate its size and rate of change.

Table 15 provides a summary of our results for total manufacturing. The first part indicates that total factor productivity growth has been highest in Quebec and the Atlantic regions and lowest in the Prairies and British Columbia. The subperiods provide an interesting contrast. During the 1960s, Ontario, British Columbia, and Quebec had the highest rates of productivity growth. During the 1970s, however, the decline in productivity growth rates was very unevenly spread across the regions: it was particularly severe in Ontario and British Columbia, severe in Quebec and the Prairies, and almost nonexistent in the Atlantic provinces.

TABLE 15
Regional productivity in Canadian total manufacturing

	Atlantic provinces	Quebec	Ontario	Prairies	British Columbia
Total Factor Productivity Growth (average annual percentages)					
1961-77	0.82	0.85	0.76	0.57	0.67
1961-70	0.82	0.95	0.98	0.69	0.97
1971-77	0.81	0.72	0.46	0.43	0.29
Total Factor Productivity Levels					
1961-77	96.5	96.3	100.0	100.7	102.4
1961-70	95.7	96.2	100.0	100.8	102.8
1971-77	97.7	96.6	100.0	100.6	101.8

SOURCE: Denny and Fuss (1980)

The relatively high growth level in the Atlantic region over the complete period was based on those provinces' maintenance of their 1960s' productivity growth during the 1970s. Similarly, the very poor results in Ontario and British Columbia during the 1970s pulled down their superior performance in the 1960s.

Moreover, although the percentage differentials in the regions' productivity growth rates were large, the absolute differentials were small, a fact that has implications for changes in the productivity levels. The second part of Table 15 indicates that the levels of productivity were not remarkably different across the country. The Atlantic provinces and Quebec had productivity levels somewhat lower than Ontario's, while British Columbia's was a little higher and the Prairies', marginally so. Because absolute differentials in productivity growth rates were small, the relative levels did not change sharply over the seventeen-year period. The changes that did occur slightly narrowed the range of productivity differentials.

These results may surprise some readers, so a few additional comments seem called for. First, the total factor productivity measured in

this study accounts for regional differences in the use of capital, labour, and materials in producing gross output. The results would be different if we had studied any variant of labour or real value-added productivity that concentrates on a subset of the inputs and a different output concept. Second, these results refer to total manufacturing; there is much more diversity when we disaggregate further (Denny, Fuss, and May [1981]). Third, the regional data are of poorer quality than the national data; improved information might alter some of our conclusions.

To give some perspective to our results on factor productivity, Table 16 presents evidence on the levels and growth of regional labour productivity. Clearly, labour productivity differs from region to region far more than total factor productivity. However, the differences in levels for the 1970s are smaller than those observed for the 1960s. Since the size of the level differences depends on differences in total factor productivity and in factor intensity and since we know the former is small, the latter must be responsible for most of the regional differences in labour productivity levels. This phenomenon suggests a need to focus on the determinants of regional differences in factor intensities, but unfortunately, no direct studies of this problem exist.

Table 16 also shows that although the growth in total factor productivity slowed sharply in most regions during the 1970s, labour productivity growth did not. Only Ontario and British Columbia had declines, and Ontario's was very small. The growth rate of factor intensity accelerated in all regions during the 1970s offsetting the declines in total factor productivity growth and thus resulting in the relatively strong performance of labour productivity during 1971 to 1977.

In brief, large differences in regional per-capita incomes persist in Canada. Yet the evidence suggests that the cause is not large differences in total factor productivity levels or growth rates. Consequently, we need to expand our investigations of other factors that can influence incomes. Moreover, the widespread nature of the gains in productivity is encouraging; we hope to evaluate the more dismal period of 1975 to 1982 to see if bad times have been distributed unequally.

TABLE 16
Regional labour productivity in manufacturing

	Growth rates		Level
	Labour productivity	Factor intensity	Labour productivity
Atlantic			
1961-77	3.76	2.94	81.5
1961-70	3.31	2.49	80.9
1971-77	4.33	3.52	83.1
Quebec			
1961-77	4.16	3.31	82.3
1961-70	3.83	2.88	82.9
1971-77	4.59	3.87	81.7
Ontario			
1961-77	3.99	3.23	100.0
1961-70	4.06	3.08	100.0
1971-77	3.90	3.44	100.0
Prairies			
1961-77	3.00	2.43	107.4
1961-70	2.84	2.15	111.8
1971-77	3.22	2.79	103.1
British Columbia			
1961-77	2.82	2.15	105.9
1961-70	3.06	2.09	111.8
1971-77	2.51	2.22	98.7

SOURCE: Denny and Fuss (1981)

8
CLOSING COMMENTS

A few comments about our current understanding of productivity will suffice to close this survey. By international standards, Canada has done quite well throughout its history, particularly during the last thirty years. Although not a leader in productivity growth, it has performed at least as well as the majority of developed nations. Within the country, the various regions have had different productivity levels, but their rates of growth have been quite similar, and evidence suggests that increases continue to occur in all of them. Yet at neither the regional nor the international level do we have an adequate understanding of the causes of productivity differentials. The recent concern over the Great Productivity Slowdown is symptomatic of our problems in understanding the processes that underlie changes in productivity.

Certainly, we have improved the conceptual basis of productivity studies and better understand the limitations of current empirical work. Unfortunately, we remain a rather long way from any ability to manage the economy so as to achieve particular rates of productivity growth. This is not very surprising. Productivity changes and levels are the outcomes of a myriad of very complicated processes. The level of output produced per units of inputs is a summary measure of performance, and it is important to remember that having a simple aggregate measure is not the same thing as knowing how to improve aggregate performance. Knowing the productivity level is similar to knowing a large corporation's profit level: larger is better, but knowing exactly why profits (or productivity) have a particular value requires a detailed investigation of the underlying structure of the firm (or the economy).

In this survey, we have not attempted to assess the policy implications of the current state of our knowledge about productivity. Productivity growth has been very slow in the early 1980s, and there is growing concern that the government must undertake some action.

Kendrick (1980b) suggests a menu of possible policies. His suggestions are reasonable but deserve only cautious support. With our current knowledge, we cannot be certain of the size of the net benefits of any policy to enhance productivity growth. Any steps taken to improve our productivity performance should be monitored carefully to ensure that the net benefits are positive.

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ISSN 0702-0643

ISBN 0-7743-7581-7